I. *An Account of Observations made on Board the*
Chatham-Yacht, *August* 3 *oth and* 3 1 *ft, and*
September 1 *ft,* 1732, *in purfuance of an Or-*
der made by the Right Honourable the Lords
Commiffioners of the Admiralty, for the Trial of
an Inftrument for taking Angles, *defcribed in*
Philofophical Tranfactions, *Numb,* 420.
By John Hadley, *Efq; Vice-Prefident of the*
Royal Society.

IN *May,* 1731, I communicated to the *Society*
the Defcription of a new Inftrument for taking
Angles, and produced a Specimen of an Inftru-
ment made accordingly. Several of the Gentlemen
to whom it was fhewn, as well then as at other
times, entertained a favourable Opinion of the Pro-
bability of its Ufefulnefs, particularly our worthy
Vice-Prefident Dr. *Edmund Halley,* Aftr. Reg. and
the Reverend Mr. *James Bradley,* Aftr. Pr. S.
not only expreffed their Defire that Trial fhould be
made of it at Sea, but promifed the Favour of their
Company and Affiftance on that Occafion.

The Inftrument produced at the *Society* was made of
Wood, according to *Fig.* IV. *Tranfact.* N° 420. of the
'forementioned Defcription, and was intended chiefly for
taking Altitudes of the Sun, Moon and Stars, from the
vifible Horizon, either forwards or backwards ; I there-
fore procured another to be made of Brafs by Mr. *J.*

Siffon,

Siſſon, for taking the Diſtance of any kind of Ob-
jects. It is ſupported by a ſingle Stem ſkrewed on
to it on the under Side, the lower End of which
may reſt on the Ground, to eaſe the Obſerver of the
Weight of the Inſtrument. This Stem is alſo
made to lengthen or ſhorten, by which Means the
Inſtrument is brought to the proper Height for
any Obſerver's Eye, either ſtanding or ſitting. In-
ſtead of a Ball and Socket, it has two circular Arches
fixed on its Back, by which it is readily ſet to
any Poſition which the Situation of the Objects may
require.

The Right Honourable the Lords Commiſſioners of
the Admiralty having been pleaſed to order the
Chatham-Yacht for the Trial of the ſaid Inſtru-
ment, and to give Directions to Mr. *James Young*,
Maſter Attendant at *Chatham*, a Gentleman well
ſkill'd in Navigation, to be preſent at the Trial, my
two Brothers and Self went on Board accordingly
Wedneſday, *Auguſt* the 30th, being favoured with
the Company (beſides the two 'forementioned Gen-
tlemen) of the Reverend Sir *Robert Pye*, Bart. and
Robert Ord, Eſq; Members of this *Society*. We
met Mr. *Young* at *Sheerneſs* the next Day, who ac-
companied us down about three Leagues below the
Nore, near the *Spile-Sand*, and was on Board on
Friday, *September* the 1ſt, when we lay by there,
and the ſeveral Altitudes of the Sun were taken as it
approached the Meridian from about Ten of the Clock
'till Noon.

The

The Obſervations were as follow.

Auguſt the 30th, near Midnight,
Mr. *Bradley* obſerved the Diſtance
of *Lucida Iyræ* from *Cor Aquilæ*
by the Braſs Inſtrument off *Graveſ-*
end in ſtill Water,   34° 13′ 30′
  The ſame repeated was   34 13 15
  The Error of the Inſtrument in that Place is 23″ to
   be ſubtracted.
  The Diſtance of thoſe Stars, accord-
ing to Mr. *Flamſteed*, is   34° 11′ 50
Which by the Refraction is reduced to 34 11 10

Auguſt the 31ſt, about 10ʰ 30′,
Mr. *Bradley* obſerved the Diſtance
of *Capella* from the *North Pointer*
in the *Great Bear's* Back, by the
ſame Inſtrument, while we lay at
Anchor in the Mouth of the *Med-*
way near *Sheerneſs*, the Wind blow-
ing hard at North Eaſt,   49° 14′ 00″+
     Or   49 15 00
  Mr. *Bradley* and my ſelf making a ſmall Difference
   in numbring the Angle mark'd by the Index.
  The Error of the Diviſion of the Inſtrument there
   is 30″ to be added.
  The Diſtance of thoſe Stars, accord-
ing to Mr. *Flamſteed*, is   49° 16′ 00″
By the Refraction reduced to   49 14 20
  Clouds coming up prevented the repeating this Ob-
ſervation, nor had we any Opportunity of making
any others of this kind.

     Z z 2   Altitudes

Altitudes of the Sun obſerved by Mr. *Bradley*, lying at Anchor in the Mouth of the *Medway*, *Auguſt* the 31ſt, Afternoon, the Wind at North-Eaſt, a freſh Gale, by the Wooden Inſtrument forwards. The Watch by the Mean of the Obſervations appeared to be about 8′ 45″ too ſlow ; the viſible Horizon being ſuppoſed 3′ 30″ depreſſed below the true by the Height of the Obſerver's Eye above the Surface of the Water, amounting to about 8 or 9 Feet.

Time by Watch.		True Time.			True Alt. of Sun's upper Limb from on, the visible add. Horizon.	Re-fraction	App.ᵗ Alt. of Sun's upper Limb from the visible observed. Horizon.	Alt. of the Sun's upper Limb observed.	Errors Observed of Di. Alt. of the vision Sun's up-per Limb instr. corrected. Subst.	Errors of Observation.
h	′	h	′	″	° ′ ″	′ ″	° ′ ″	° ′ ″	′ ″	′ ″
5	05	5	20	35.9	50 31.4	54.9	55 25.9	57 00	2 15.9	— 0 40
11	30		25	15	07 00.5	17.1	12 17.1	13 30	2 00.8	— 1 02
16	20		27	05.8	58 49.5	27.6	198	30 30	2 00.7	0 49
18	20		30	05	525	44.6	35.7	57 30	2 15.8	0 35
21	5		36	39	21 18.6	28.7	12.7	27 30	2 15.6	— 0 18
28	55		39	50.7	44.6	8.7	08.7	05 00	2 15.6	0 35
30	25		41	10	55 22.6	46	02	48 00	2 00.6	+ 0 37
32	30		45	10	38 13.7	03.6	45 16.6	10 00	3 15.5	+ 0 45
36	37		47	22.5	00 07.7	40	07	05 00	2 15.5	+ 0 45
38	30		49	20	118 08.8	03.5	48 14.5	34 00	2 15.5	+ 1 51
40	34		51	19	03 14.8	24	30 12	15 00	3 00	+ 1 31
42	50		52	354	249 08	50.07	04 31	03 30	3 00	1 04
43					51 08	07				

Altitudes of the Sun, obferved *September* the 1ft, before Noon, under Sail from *Sheernefs* towards the *Spile-Sand*, with the Tide of Ebb, the Wind blowing hard at North-Eaft, by the Wooden Inftrument forward. The fecond Speculum being removed by fome Accident from its due Pofition, fo as to increafe the Angles obferv'd about one Degree three Minutes and a half, as appeared by the firft Obfervations of the Afternoon of the fame Day, made with the fame lnftrument, in the fame manner, while we continued lying-by near the *Spile* ; and that Degree and three Minutes and a half are added to the Errors of the Divifions of the Inftrument in the feventh Column. While thefe Obfervations were making, the Yacht fteered at firft chiefly Eaft, fometimes South-Eaft, afterwards ftood to the North-Eaft, towards the *Swin*. The Time of the Watch was regulated by fome of the later Obfervations made when we were moft Eaftward, and this was probably the Caufe why the firft Altitudes, which were taken while we were more Wefterly, fall fo much fhort of the Computations, the Difference decreafing gradually as we advanced towards the Eaft.

Altitudes

Altitudes obſerved by Mr. *Bradley*.

Time by Watch.	True Time.	True Alt. of the Sun's lower Limb from the viſible Horizon.	Refraction, lower Limb from the viſible Horizon, add.	Appt Alt. of the Sun's lower Limb from the viſible Horizon.	Altitude of the Sun's lower Limb obſerved.	Errors of the Inſtrument ſubtract.	Obſerved Altitude of the Sun's lower Limb correćted.	Errors of Obſervation.
h. ′ ″	h. ′ ″	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	° ′ ″	′ ″
7 09 57	18 15 57	15 15 05	393 15	15 15 08	54 16 09	1 5 45 15	15 03 15	−5 39
11 44	20 44	28	133 11	31 24	33 00	1 5 45	27 15	−4 09+
13 58	22 58	45	235 08	48 31	49 00	1 5 45	43 15	−5 16
14 53	23 55	45 33	453 05	59 48 17	02 00	1 5 45	56 15	−3 33
16 33	25 33	16 11	473 02 16	14 49	18 00—	1 5 45 16	12 15—	−2 34+
18 04	27 04	25	312 59	28 30	32 00	1 6 45	26 15	−2 15
18 54	27 54 17	18	002 50 17	20 50 18	25 00	1 6 30 17	19 30	−1 20
23 54	34 54	33	312 47	36 18	43 00+	1 6 00	37 00	−1 42+
25 38	36 38	58	58 23 18	01 19	07 00—	1 6 00 18	01 00	−0 06+
28 25	37 25	19	042 40	44	28 00	1 5 00	23 00	+1 16
30 44	39 44 18	09	35	21 44	00 00	1 5 30	55 30	+1 45
34 21	43 21	51	102 35	53	16 00	1 4 30 19	11 30	−0 21
36 24	45 24 19	09	182 19	45 51	00 00	1 4 30	30 30	+1 06—uncertain
38 44	47 44	29	542 18	11	38 00—	1 4 30	33 30	+1 00
40 50	49 50	45	272 30	32 24	52 00—	1 4 30	47 30	−0 25—
42 00	51 00	58	412 28	47 55	00+	1 4 30	59 30	−1 37—
45 34	54 34 34 20	29	2620 20	01 07 21	00 00	1 4 30 20	30 30	−1 43
45 34	54 20	29	512 22	32 13	35 00	1 4 00	30 30	

The

The same continued by Mr. John Hadley.

Time by Watch.	True Time.	True Alt. of the Sun's lower Limb from the visible Horizon.	Refraction, add.	Appt Alt. of the Sun's lower Limb from the visible Horizon.	Altitude of the Sun's lower Limb observed.	Errors of the Instrument (subtract).	Observed Altitude of the Sun's lower Limb corrected.	Errors of Observation.
h. ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	′ ″
7 52 18	01 08	21 28 21	2 15	21 30 36	22 36 00—	1 4 30	21 31 30	+0 54 —
54 18	03 18	45 43	2 13	47 56	52 00	1 4 30	47 30	—0 26
55 40	04 40	57 25	2 12	59 37	04 00	1 4 30	59 30	—0 07
58 22	07 22	22 20 34	2 09	22 22 43	23 30 00	1 5 15	22 24 45	+2 02 uncertain.
8 02 51	11 51	58 46	2 06	00 52	04 00	1 5 15	58 45	—2 07
09 19	18 19	23 53 26	2 00	23 55 26	24 00 00+	1 5 30	23 54 30+	—0 56 —
13 10	22 10	24 25 35	1 57	24 27 32	25 32 00	1 5 30	24 26 30	—1 02
14 45	23 45	38 43	1 56	40 39	45 00+	1 5 30	39 30+	—1 09 —
16 55	25 55	56 24	1 55	58 19	03 00	1 5 30	57 30	—0 49
19 05	28 05	25 14 34	1 53	25 16 27	26 22 00+	1 5 30	25 16 30+	—1 03 +
22 57	31 57	46 14	1 51	48 05	52 00—	1 5 30	46 30—	—1 35 +
25 05	34 05	26 03 35	1 49	26 05 24	27 10 00—	1 5 30	26 04 30—	—0 54 +
26 43	35 43	16 50	1 48	18 08	22 00+	1 5 30	16 30+	—1 38 —
28 20	37 20	29 54	1 47	31 41	35 00	1 5 30	29 30	—2 11

Altitudes

Altitudes of the Sun, observed lying-by near the *Spile*, *September* the 1st, before Noon, with the Wooden Instrument backward, the Wind continuing to blow hard, as before, at North-East. The Instrument when used for the back Observation was so adjusted, as to allow for a Dip of the visible Horizon of two Minutes and a half; consequently that Dip being supposed, as before, three Minutes and a half, there remains only one Minute to be accounted for, in computing the Height of the Sun, which is accordingly subtracted in the third Column from the Altitudes found by Computation. The Watch now appeared to be 9' 30" too slow.

Altitudes observed by Mr. *John Hadley*.

Time by Watch			True Time			True Alt. of the Sun's upper Limb, on, add.			Refraction, subtr.		Appt Alt. of the Sun's upper Limb.			Alt. of the Sun's upper Limb observed.		Errors in the Division, on, subtr.		Observed Altitude of the Sun's upper Limb corrected.			Errors of Observation.
h.	'	"	°	'	"	°	'	"	'	"	°	'	"	°	'	°	'	°	'	"	' "
9	52	55	10	02	25,36	52	54	1	11	36	54	05	36	46	00	1	00	36	45	00	−9 05
10	02	07	11	37,37		37	37	1	09	37	44	46	37	44	00	1	00	37	43	00	−1 46
	06	00	15	30,38		30	38	1	08	38	04	38	04	00		1	00	38	03	00	−2 08
	08	53	18	33	38	19	00	1	08		05	08	38	20	22	1	00	21	00	00	+0 52
	12	25	21	55		00	01	1	07		08	08	41	00		1	30	39	30		+1 58
	16	30	26	56		36	25	1	07		57	37	32			1	30	58	30		+1 15
	18	50	20	07	39	01	06	0	39		08	06	06	00		0	30	05	30		−2 43
	20	40	30	10		15	26	1	06		16	32	13	00	14	0	30	13	30		−3 02

The

The same continued by Mr. *Bradley*.

Time by Watch.			True Time.			True Alt. of the Sun's upper Limb.			Refraction, add.		Appt Alt. of the Sun's upper Limb.			Alt. of the Sun's upper Limb observed.			Errors in the Division. Subtr.		Observed Altitude of the Sun's upper Limb corrected.			Errors of Observation.		
h.	′	″	h.	′	″	°	′	″	′	″	°	′	″	°	′	″	′	″	°	′	″	′	″	
10	30	18	10	39	48	39	57	28	1	04	39	58	32	40	00	00	2	00	39	58	00	0	32	
	33	23		42	53	40	10	02	1	06	40	11	06		12	00	2	00	40	10	00	1	06	—
	35	53		45	23		19	51	1	04		20	55		16	00	2	00		14	00	6	55	+
	37	48		47	18		27	13	1	03		28	16		32	00	2	30		29	30	1	14	+
	39	22		48	52		33	03	1	03		34	06		36	00	2	30		33	30	0	36	

Continued yb Mr. *Henry Hadley*.

h.	′	″	h.	′	″	°	′	″	′	″	°	′	″	°	′	″	′	″	°	′	″	′	″	
11	08	05	11	17	35	41	59	36	1	00	42	00	36	42	15	00	2	30	42	12	30	11	14	+
	16	20		25	50	42	16	36	1	00		17	36		20	00	2	30		17	30	0	06	
	22	00		31	30		25	48	0	59		26	47		31	00	2	45		28	15	01	28	+
	24	20		33	50		29	35	0	59		30	54		34	00	2	45		31	15	00	41	+
	28	00		37	30		34	27	0	59		35	26		39	00	2	45		36	15	00	49	+
	33	45		43	15		40	32	0	58		41	30		45	00	3	00		42	00	00	30	+
	37	45		47	15		43	25	0	58		44	41		48	00	3	00		45	00	00	19	+
	40	30		50	00		45	25	0	58		46	23		49	00	3	00		46	00	00	23	+
	43	00		52	30		46	34	0	58		47	32		51	00	3	00		48	00	00	38	+
	47	00		56	30		47	42	0	58		48	40		52	00	3	00		49	00	00	20	+
again.															52	00	3	00		49	00	00	00	
again.	14	00		48	00	00				0	58		49	00		52	00	3	00		49	00	00	00	

Between each of the five last of these Observations the Index was removed so as to make them entirely independent of one another; and from their near Agreement among themselves, and with good Part of the preceding, I conclude the true

Height of the Sun's Center above the real Horizon at Noon was exactly enough 42° 33' his Semidiameter being 16 Min. from which, and the Sun's Declination 4° 1' the Latitude of the Place will be 51° 28', which is accordingly used in all the Computations.

Altitudes of the Sun observed *September* 1, 1732, Afternoon, near the *Buoy of the Spile*, and under Sail Westward, by the Wooden Instrument forwards, the second Speculum remaining displaced as in the Morning.

Altitudes observed by Mr. *Bradley*.

Time by Watch.	True Time.	True Alt. of the Sun's lower Limb from the visible Horizon.	Refraction lower Limb the visible Horizon. add.	Appt Alt. of the Sun's lower Limb from the visible Horizon.	Altitude of the Sun's lower Limb observed.	Errors of the Instrument subtract. the Sun's lower Limb.	Observed Altitude of the Sun's lower Limb corrected.	Errors of Observation.
h. ' "	h. ' "	° ' "	' "	° ' "	° ' "	' "	° ' "	' "
12 07 30	12 17 00	42 12 13	1 00	42 13 13	42 13 45	1 6 0	42 14 07	+0 47
12 08 50	12 18 00	42 07 11	1 09	42 08 12	42 12 19	1 6 0	42 13 00	+0 51
12 12 00	12 21 30	42 00 18	1 00	42 01 18	42 01 13	1 6 0	42 07 00	—1 18
12 19 50	12 29 20	41 56 00	1 00	41 57 00	41 13 00	1 6 0	41 55 00	—2 00

The same continued by Mr. *Henry Hadley*.

Time by Watch.	True Time.	True Alt. lower Limb.	Refraction add.	Appt Alt. lower Limb.	Altitude observed.	Errors of Instr. subtract.	Observed Alt. corrected.	Errors of Observation.
h. ' "	h. ' "	° ' "	' "	° ' "	° ' "	' "	° ' "	' "
1 00 00	1 09 30	30 40 09	21 03 40	24 41 13	00	1 6 0	40 07	—3 24 uncertain
1 01 35	1 11 05	30 20 03	01 04 04	24 10	00	1 6 0	04 04	—0 24
1 03 02	1 12 32	32 39 57	59 04 39	59 03	00	1 6 0	39 58	—1 03
1 04 21	1 13 51	52 57	57 04	54 01 02	00	1 6 0	56 56	+1 59
1 06 14	1 15 44	44 31	31 04	46 35 52	00	1 6 0	46 00	+1 35
1 07 30	1 17 00	40 28	28 04	41 32 49	00	1 6 0	43 00	+1 28
1 08 45	1 18 15	35 37	37 05	36 42 40	01	1 6 0	54 00	+1 42
1 10 00	1 19 30	30 28	28 05	31 33 38	01	1 6 0	32 00	+0 27
1 11 29	1 20 59	24 21	21 06	25 28 34	01	1 6 0	28 00	+2 32
1 14 25	1 23 53	11 46	01 06	12 52 18	01	1 6 0	12 00	—0 52 uncertain

The firſt and ſixth Columns of the preceding Tables of Obſervations are copied from the Minutes as they were ſet down at the Time. The Diviſions of the Wooden Inſtrument being not exact, I found it neceſſary to make a Table to correct them by, which was done partly by meaſuring with Compaſſes, and partly by examining them againſt thoſe of another Inſtrument. The Corrections are every where to be ſubſtracted from the Angles obſerved, and the Errors of a Degree and three Minutes and a half, occaſioned by the miſplacing the ſecond Speculum in all the forward Obſervations of *September* the 1ſt, being of the ſame kind, are joined with them, in the ſeventh Column of the Tables of thoſe Obſervations. The laſt Column contains the Differences between the obſerved Altitudes, corrected by the 'forementioned Table, and the Altitudes as they ought to have appeared by the Computations. Among them there are two or three which ſo much exceed any of the reſt, that for that reaſon they ſeem to be rather owing to Miſtakes, in counting the Minutes on the Inſtrument, or the Time by the Watch, than to the Errors of the Obſervations.

The greateſt Part of the Altitudes were taken by a Horizon not clear of Land, and by that Means not always ſo readily diſtinguiſhable. The Obſervers were all Perſons quite unaccuſtomed to the Motion of a Ship at Sea, which in this Caſe was generally very great and quick, the Veſſel we were in being only of about 60 Tuns Burthen, as the Maſter informed us, the ſmallneſs of which made it alſo more liable to be lifted up and let down again by the Waves: And if the Difference of Height occaſioned by that Means was about four or five Feet, as we judged it to be, it
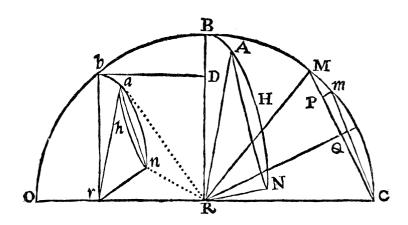
muſt

muſt neceſſarily ſink and raiſe the viſible Horizon by
Turns near one Minute. The Computations of the
Sun's Altitudes are all made for the Latitude of
51° 28', whereas a good Part of them were taken
under Sail, and upon different Tacks, the Veſſel ſome-
times ſtanding North Eaſt or North, and at other
times South Eaſt, for near a quarter of an Hour
at a time.

Several of theſe Circumſtances may probably have
contributed to increaſe the Inconfiſtency of the Ob-
ſervations; but as no particular Notice was taken of
them at the Time, I content my ſelf with barely
mentioning them.

P O S T S C R I P T.

The Principle on which the Contrivance of this In-
ſtrument depends, was laid down in the before-men-
tioned *Philoſ. Tranſ.* Numb. 420. in one Propoſition,
and ſeveral *Corollaries*, the fifth of which contains
the Grounds of an Approximation for correcting
ſome ſmall Errors which will ariſe if the Plane of
the Inſtrument be ſuffered to vary too much from
the great Circle paſſing through the two Objects,
when the Obſervation is taken. There appears rea-
ſon to think, that there will be very little Occaſion in
Practice for that Correction; but it was neceſſary to
mention it, in order to explain the Nature of the In-
ſtrument; and as the manner of deducing that Co-
rollary from the Propoſition may not appear obvious
to every Reader, I have here annexed the Demonſtra-
tion of it.

Let O B C in the annexed Figure reprefent an infinite Sphere, at whofe Center R are placed the two Specula inclined to one another in any given Angle, and let their common Section coincide with the Diameter O R C. Let B A N be the Circumference of a great Circle, to the Plane of which the common Section of the Specula O R C is perpendicular, and B R its Radius: Let *b a n* be the Circumference of a Circle parallel to B A N, and at the Diftance from it B *b* : Draw *b* D the Sine, and *b r* the Sine complement of the Arch B *b* : B D is the verfed Sine of the fame. Let A be a Point of an Object placed in the Circumference of the great Circle B A N, and N the Point in which its Image is formed by the two fucceffive Reflections, as before defcribed; and let *a* be a Point of another Object placed any where in the Circumference of the Parallel *b a n*, and *n* its Image; and let *a h n* be an Arch of a great Circle paffing through the Points *a* and *n*. The Point *a* is at the fame Diftance from the great Circle B A N, as the Point *b*,

i. e.

i. e. at the Diftance B *b*. Draw A R, A N, R N, *a r*, *a n*, *r n*, *a* R and *n* R.

By the fourth Corollary the Figures A R N and *a r n* are fimilar, and confequently the Line A N is to the Line *a n* as A R or B R is to *a r* or *b r*, *i. e.* as the Radius is to the Sine complement of the Diftance B *b*. But A N is the Chord of the Arch A H N of the great Circle B A N equal to the Tranflation of the Point A, or double the Inclination of the Specula, and *a n* is the Chord of the Arch *a h n* of a great Circle, meafuring the Angle *a* R *n*, by which the Point *a* appears removed by the two Reflections, to an Eye placed in the Center R. Therefore the Tranflation, or apparent Change of Place of the Point *a* is meafured by an Arch of a great Circle, whofe Chord is to the Chord of the Arch A H N (equal to double the Inclination of the Specula) as the Sine complement of its Diftance from the great Circle B A N is to the Radius.

From any Point C of the Circumference O B C draw the Chords C M and C *m*, to the fame Side of the Point C, and equal to the Chords A N and *a n* refpectively, draw the Radius R M, and from R and *m* draw R Q and *m* P, both perpendicular to C M, and cutting it in Q and P. R Q is the Sine complement, and C M double the Sine of half the Angle M R C, or A R N, or of the Angle of Inclination of the Specula. The little Arch M *m* will reprefent the Difference of the apparent Tranflations of the Objects in A and *a* ; and if it be very fmall, may be looked on as a ftrait Line, and the little mix'd Triangle M *m* P as a rectilinear one, which will be fimilar to R M Q, becaufe R M is perpendicular to M *m* and
R Q

R Q to C M, and the Angles at Q and P right Angles. The Line C P may be taken as equal to C *m*, and M P as the Difference of the Lines C M and C *m*. Therefore the little Arch M *m* is to the Line M P nearly as R M to R Q : But C M (*i. e.* A N) was to C *m* (*i. e. a n*) as B R to *b r*, and the Difference M P of C M and C *m* to the Difference B D of B R and *b r* as C M to B R. Therefore M *m*, the Difference of the apparent Tranflations, is to B D, the verfed Sine of the Diftance B *b*, or to an Arch equal to it, in the compound Ratio of R M the Radius to R Q the Sine complement of the Angle of Inclination of the Specula, and C M double the Sine of the fame to B R the Radius, *i. e.* as C M to R Q.

The Obfervation may be corrected by one eafy Operation in Trigonometry, as will appear from the firft Part of this Corollary, *viz.* by taking the half of the Angle obferved, and then finding another Angle, whofe Sine is to the Sine of that half, as the Sine complement of the Diftance B *b* is to the Radius: This Angle doubled, will be the true Diftance of the Objects. But as this Operation, though eafy, will require the ufe of Figures, I rather chofe the Method of Approximation, becaufe by that the Obferver, retaining in his Memory the Proportions of the Sines of a few particular Arches to the Radius, may eafily eftimate the Correction without Figures, when the Angle is not great, and by a Line of artificial Numbers and Sines, may always determine it with greater Exactnefs than will ever be neceffary.

When the Angle obferved is very near 180 Degrees, the Correction may be omitted ; for then it will be

eafy to keep the Plane of the Inftrument fo near that of the before-mentioned great Circle as not to want any, if the Situation of that Circle be known: If it be not, the Obferver, when he fees the two Objects together, may turn the Inftrument on the Axis of the Telefcope, 'till he finds that Pofition of it by which he obtains the leaft Angle; and this (if the Specula are fet truly perpendicular to the Plane of the Inftrument) will always happen when the Objects appear to coincide in the Line g h, as expreffed in the third Fig. of *Tranf.* No 420.

In Page 152 of the fame, a Rule is given for finding to which Hand of the Obferver the Object feen by Reflection ought to lie, but is reftrained to the particular Form of the Inftrument there defcribed. The general Rule is, that when the Index is brought to the beginning of the Scale (*i.e.* to 0° when the Inftrument is defigned for Angles under 90°, or to 90° when it is defigned for Angles from 90° to 180°) if then a Line be imagined to be drawn on it parallel to the Axis of the Telefcope, or Line of Direction of the Sight, fo as to point towards the Object feen directly; which ever way this Line is carried by the Motion of the Index along the Arch from 0° towards 90° in the firft Cafe, or from 90° towards 180° in the fecond, the fame way the Object feen by Reflection ought to lie from that which is feen directly.

Erratum, Pag. 154. Line 24, read, *They may be either of Metal, or Glafs Plates foil'd, having their two Surfaces,* &c.

II. Ephe-